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# Sorghum Diseases Atlas

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# Sorghum Diseases Atlas

C. Wendell Horne and Robert W. Berry*

## INTRODUCTION

Grain sorghum diseases limit production and reduce net profit. Producers sometimes overlook damage, especially when several diseases occur at low levels. Collectively this damage may be greater than one would expect at first glance.

Recognition and correct identification are essential before taking steps to avoid losses. This publication will enable producers to diagnose problems accurately and select proper control procedures.

Most diseases that reduce grain sorghum yields can be prevented easily by using resistant hybrids or cultural practices. Because no hybrid is resistant to all diseases, one must know which diseases are occurring on his farm. Wise selection of hybrids and cultural practices can pay handsome dividends.

New diseases and variations of old ones can occur at any time, so maintain constant vigilance for new disease problems. If a new disease threat is observed when it first occurs, little damage may result. If it is overlooked, however, the disease may increase to where damage becomes severe in the following years.

Some organisms causing specific diseases are pictured in this publication to help growers recognize the relationship between disease symptoms and organisms having specific characteristics. While microscopic in size, these organisms are just as real as weeds growing in a field. Their presence determines whether the disease occurs, and population size determines severity of damage.

Alertness to disease occurrence is essential to avoiding crop losses.

* Extension plant pathologists, The Texas A&M University System.

## SEED ROTS AND SEEDLING DISEASE

Getting a stand is the first hurdle of the production year. Fortunately, grain sorghum has fewer problems in this area than most other major crops. Few stands are lost from the independent action of organisms causing seedling disease. The organisms do, however, cause seed rot and some seedling disease, especially when adverse weather and soil conditions interact.

Most grain sorghum stands are lost when hard, packing rains seal the soil surface and soil temperatures are cold. Emergence is slowed, and soil organisms may use the seed as a food source. Seed are placed at a disadvantage, and organisms are favored by cool temperatures.

After emergence in cold soils, plants may have a purple color and grow very slowly. While organisms can be isolated from plant parts, this symptom is nutritional in nature. Phosphorus uptake is poor in cold soils, and purpling causes temporary phosphorus deficiency.

Very young seedlings produce two sets of roots. The earliest roots, called primary roots, function for only about 2 weeks, then perish. Secondary roots are produced at the base of the developing plant before primary roots die. They are permanent and support future plant growth. Occasionally, when soils are very dry, secondary roots do not find enough moisture and fail to develop properly. As the primary roots cease functioning and since there are no secondary roots, many seedlings may die. This could be considered a seedling disease, but actually the cause is drought related.

Low quality seed are more likely to be susceptible to disease organisms. Use high quality seed that have been treated with a protectant fungicide. Chemical seed treatment compounds usually are applied by the seed companies before seed are sold to the producer.

Sorghum downy mildew on developing grain sorghum plant. (*Horne*)

## SORGHUM DOWNY MILDEW

Sorghum downy mildew caused by the fungus *Peronosclerospora sorghi (Sclerospora sorghi)* was first observed in Texas in 1961 and became epidemic in 1967. Its greatest damage has been restricted to areas along the Texas Gulf Coast even though individual fields in other areas have been affected. Widespread adoption of resistant hybrids has served to substantially reduce damage and curtail spread.

Infected sorghum plants have striped leaves with a downy growth on the lower surface. The striping is characterized by light green to yellow streaks within the green leaf. Young plants showing this symptom are systematically infected and will be sterile. Late infection sometimes occurs, leaving plants with partially or completely sterile heads.

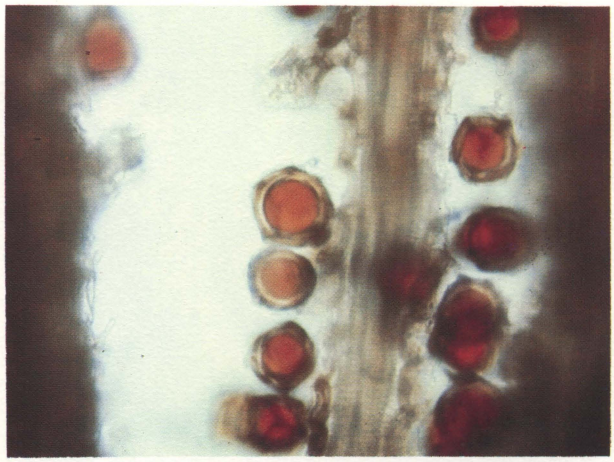
Disease symptoms change throughout the growing season. Small, infected seedlings are lighter colored than healthy ones and often have a thick coating of down (spores) on the lower leaf surface. Obvious leaf striping generally does not develop until plants are about 6 inches tall. Many heavily infected young plants may die.

In the latter part of the season, systemically infected leaves shred, and individual plants may look as though they have been through a hail storm. Fungal development within the leaf tissue causes cells along the veins to rupture, releasing spores produced in that area. These spores are thick-walled and serve to carry the fungus through the winter season. The resting spores may survive several years and infect later sorghum plantings.

Resistant hybrids seldom have more than 2 percent infected plants. This virtually eliminates

Typical striping on older grain sorghum plant. (*Horne*)

Leaf shredding associated with systemically infected plants. (*Horne*)



Overwintering spores of the sorghum downy mildew fungus that have formed along veins within the leaf tissues. (*Frederiksen*)

economic loss and reduces the number of spores carried over in the soil. Economic loss is usually not noticeable until systemically infected plants reach the 20 percent level. Infected plants are smaller and do not compete at the same level for water and nutrients as do healthy plants. Even low levels of infection are a concern, however, because the soil's spore population will increase greatly. This makes it difficult, if not impossible, to grow susceptible hybrids in the future without potentially serious loss.

In the Texas Gulf Coast area, plant hybrids with a high level of resistance. If this is not done, rotate with unrelated crops and avoid planting highly susceptible forage sorghums. Growers in other parts of the state should watch for increases in occurrence of the disease.

## CRAZY TOP DOWNY MILDEW

Crazy top downy mildew is caused by the fungus *Sclerophthora macrospora* and produces sterility in the plant as does sorghum downy mildew. Symptoms differ from sorghum downy mildew, however. Leaves are thickened with rough bumps and ridges along the surface. Some leaves twist together and turn downward giving the plant an unusual appearance. Affected plants also produce many shoots or suckers, giving a bunched appearance.

High moisture levels and flooding are required for disease development. The fungus produces swimming spores that need water for distribution. It is always most noticeable in fields where overflow occurs or in low spots where water stands. Naturally, the fungus must be present and producing swimming spores. Otherwise flooding does not produce the disease condition. Diseased plants produce thick-walled rest-

Stunting and sterility of grain sorghum caused by the crazy top downy mildew fungus. (*Horne*)

Leaf thickening and ridging associated with crazy top downy mildew. (*Frederiksen*)

ing spores similar to those in sorghum downy mildew. They may remain dormant in soil for a long period.

The crazy top downy mildew fungus also affects several other members of the grass family, including bermudagrass, which is widely distributed in Texas. Water draining from pastureland often contains spores that affect sorghum and corn when the drainage water washes into those fields.

Some hybrids are more susceptible than others, but these differences are not great. All commercial hybrids are susceptible to some degree. Resistance to the sorghum downy mildew fungus has no relationship to crazy top.

Producers who experience crazy top should avoid planting sorghum in fields where the problem consistently occurs. Improved drainage and diverting water movement may be helpful.

## MAIZE DWARF MOSAIC

### Field Symptoms

Maize dwarf mosaic virus infection produces a distinctive mottling in leaf tissue. When compared to healthy leaves, infected ones are yellow with light green islands. The symptoms are more clearly seen on young leaves than on older leaves. When the plant reaches the boot stage, no symptoms are visible on the leaves.

Symptoms produced by maize dwarf mosaic virus (MDMV) infection on grain sorghum. (*Horne*)

All grain sorghum plants of present, commercially grown hybrids are susceptible to infection. Tolerant hybrids, however, do not develop severe symptoms or show stunting. Even though they become infected, they tolerate the virus and suffer little or no yield loss.

Time of infection determines how much yield loss is likely to occur on susceptible hybrids. If plants are infected before reaching 45 days of age, losses are greater than if infection occurs later.

Mottling is the most consistent symptom, but other symptoms may also occur. Red leaf occurs when highly susceptible hybrids become infected and growing temperatures fall below 55° F. The symptom is more severe on older leaves, with dead tissue forming in strips and at leaf tips. Spring occurrence of this symptom in South Texas subsides after the cool period passes and weather warms for the growing season. In Northwest Texas, infected susceptible hybrids may be killed when cool nights occur consistently. Red leaf symptoms usually develop in Northwest Texas after August 1.

Red leaf symptoms of MDMV occurring on grain sorghum. (*Horne*)

Losses from maize dwarf mosaic virus are easily prevented by using tolerant hybrids. All hybrids affected by the red leaf condition are considered susceptible as are those showing stunting. High-yielding hybrids with resistance to maize dwarf mosaic virus are available for all parts of the state.

**Virus Infection and Transmission**

Maize dwarf mosaic is caused by an aphid-transmitted virus. Once virus particles are injected into plants, they multiply rapidly and become systemic within all tissues except seed. This virus is a flexuous rod visible only with an electron microscope. Several aphids, including the corn leaf aphid and the greenbug, transmit the virus to sorghum.

Virus particles are carried in the aphid's mouth parts and are injected into living tissue during the feeding process. Multiplication of these particles begins, and symptoms are evident in most sorghum hybrids after 8 to 12 days. Aphids feed on infected plants and then move to nearby healthy plants transmitting the virus.

Once plants become infected, they remain that way throughout their lives. No treatment destroys particles within the living plant. Once the plant dies, however, the virus is no longer infectious. Crop residue does not contribute to carryover of the virus.

Flexuous rod of MDMV. (*Toler*)

**Host Plant Relationships**

Maize dwarf virus particles require living host tissue to survive. Johnsongrass serves almost exclusively as the source of overwintering inoculum because its fleshy rhizomes live underground and are protected by the soil. Johnsongrass seed, like those of sorghum, do not become infected. Johnsongrass seedlings emerge healthy while shoots from infected rhizomes have symptoms as they emerge. Young seedlings

Mottling of johnsongrass leaves resulting from infection by MDMV. (*Horne*)

soon become infected, however, if aphids are present to carry the virus from infected johnsongrass rhizomes.

Johnsongrass usually emerges in the spring before grain sorghum. This often furnishes an early source of aphids and virus particles. Johnsongrass control, in and around the grain sorghum field, is most helpful in preventing early infection.

A wide range of annual and perennial grasses are susceptible to maize dwarf mosaic virus. Most grasses are of little consequence when compared to johnsongrass, which is so widespread in grain sorghum-producing areas. Its genetic and developmental characteristics are closely related to grain sorghum, so johnsongrass is ideally suited for surviving in sorghum fields and maintaining a virus source.

Control maize dwarf mosaic virus by using resistant hybrids and by controlling johnsongrass. Control aphids only when their feeding on plants is damaging. Aphid control does not reduce maize dwarf mosaic virus in a field without the other practices.

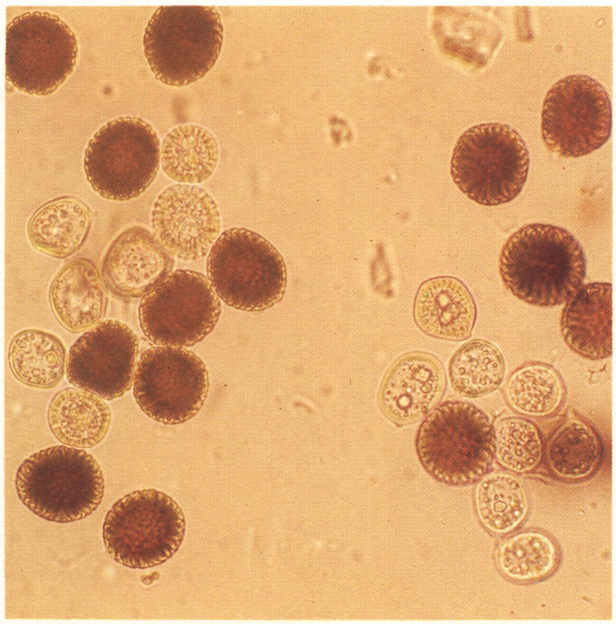
## HEAD SMUT

Sorghum plants infected with the head smut fungus *Sphacelotheca reiliana* appear normal until heading time. At heading, a large smut gall appears in place of the panicle, and no grain is produced. The entire head turns into a mass of dark brown, powdery spores. The gall is first covered with a whitish membrane, which soon breaks up, allowing spores to scatter by wind and rain to the soil. The fungus overwinters in the soil and can survive for several years.

Infection takes place in young seedlings where the fungus grows systemically in the growing point of the plant. As the flower head develops, the fungus takes over the growing tissue and forms the smut gall. Growing susceptible hybrids in the same field year after year produces a rapid increase in spore numbers, which causes a higher percentage of plants to become infected in successive crops.

Head smut is controlled effectively by growing resistant hybrids. Most commercially available

Field symptoms of head smut. (*Horne*)



Spores of the head smut fungus. (*Frederiksen*)

hybrids are resistant to older strains of the smut fungus, but new races have developed that affect them. Fortunately, scientists have found new and more stable sources of resistance, which are being incorporated into new hybrids. Consult seed companies and disease rating publications to determine whether hybrids have resistance needed for races occurring in your locality. Seed treatment does not prevent head smut, but crop rotation helps.

Covered kernel smut. (*Frederiksen*)

## COVERED KERNEL SMUT

This fungal disease *(Spacelotheca sorghi)* generally destroys all kernels in a head. Individual kernels are replaced by a cone-shaped smut gall. It is first covered by a light gray or brown membrane that later ruptures to release dark brown spores at harvest time. This smut disease differs from head smut because the entire head is not destroyed. Seed are replaced by individual smut balls, but the branching structure of the sorghum head is normal.

Occurrences of this smut are quite rare because most seed are treated with a protectant fungicide. Spores normally are carried on the seed surface and penetrate at germination. Fortunately, commercial seed handling procedures prevent this disease from becoming well established. Be alert to the occurrence of this disease because it was the most destructive disease of grain sorghum in the United States before chemical seed treatments came into general use.

## LOOSE KERNEL SMUT

Individual galls are formed by the loose kernel smut fungus *(Spacelotheca cruenta)*. Galls are long and pointed with a thin membrane covering the individual galls. At maturity the membrane breaks away, and the dark, round spores are released quickly. A long dark, stem-like structure stays in the central part of the remaining gall. It differs primarily from covered kernel smut because galls are long and pointed as opposed to round with covered kernel smut.

Unlike covered kernel and head smut, this particular smut fungus causes infestation of healthy kernels within the field. It also is seed-transmitted and causes infection of the sorghum seedling. Like covered kernel smut, this particular disease has become obscure with chemical seed treatment. It is a minor problem since most seed are treated with a protectant fungicide.

Loose kernel smut. (*Castor*)

Leaf blight. (*Rosenow*)

Gray leaf spot. (*Rosenow*)

## FOLIAR DISEASES CAUSED BY FUNGI

Foliar diseases of grain sorghum usually occur during high atmospheric moisture, generally in the latter part of the growing season. Some hybrids are highly susceptible to attack while others are quite resistant. Leaf spotting or streaking from infection reduces the amount of tissue for manufacturing plant food to store in the grain. If infection occurs early in the growing season, losses are greater than if spotting occurs at grain maturity.

Foliar disease damage is infrequent, and selection of resistant hybrids is not necessary. Fungicides applied experimentally control foliar diseases, but losses have not justified development of routine chemical control. It is entirely possible, however, that foliar disease may become more serious in the future. All control methods including chemical, cultural and genetic resistance should be developed continuously in case they are needed. The following chart describes the most common leaf spot diseases:

| Name | Pathogen | Shape | Size | Color | Characteristics |
|---|---|---|---|---|---|
| Leaf blight | *Helminthosporium turcicum* | Irregularly shaped | 1 inch to many | Gray with tan to reddish borders | Very large elongated spots |
| Target leaf | *Helminthosporium sorghicola* | Round, elliptical spots | 1/8 inch to 3/8 inch to 7/8 inch | Tan to reddish purple with tan borders | Minor significance |
| Anthracnose | *Colletotrichum graminicola* | Elliptical | 1/8 inch to 7/8 inch | Tan to red with distinct margin | Setae and spore masses common in lesions |
| Gray leaf spot | *Cercospora sorghi* | Elongate to rounded | 1/4 inch and larger | Dark purple | Grayish when the pathogen is producing spores |
| Zonate leaf spot | *Gloeocercospora sorghi* | Irregular to semi-circular | Patches of lesions running together | Alternating dark and light bands of tissue | Similar to the red leaf symptom produced by maize dwarf mosaic virus |
| Rough leaf | *Ascochyta sorghina* | Broad, elliptical | 1/4 inch x 1/2 inch | Grayish to yellow or purple | Rough to the touch because of raised fruiting bodies |

Zonate leaf spot. (*Horne*)

## FOLIAR DISEASES CAUSED BY BACTERIA

Three diseases are caused by different bacteria that occur on Texas grain sorghum. They are listed as follows:

Bacterial Stripe *(Pseudomonas andropogoni)*
Bacterial Streak *(Xanthomonas holcicola)*
Bacterial Spot *(Pseudomonas syringae)*

Bacterial stripe (left) and bacterial streak (right). (*Rosenow*)

While these organisms produce symptoms, which differ when side by side comparisons are made, it is difficult to make specific determinations on the basis of field symptoms. Generally, bacterial stripe and bacterial streak produce a linear lesion, which first has a watersoaked appearance. The lesion develops into a dry strip of dead tissue with a reflective glaze on the surface when viewed in proper light. Bacterial spot is more easily distinguished from stripe and streak. Bacterial spot lesions generally are round with a dark margin.

These diseases occur sporadically and never cause yield loss. In recent years, the most consistent occurrence has been on certain tropically adapted hybrids with low resistance. Losses were not significant even on susceptible hybrids.

Crop rotations, clean tillage and resistant hybrids control bacterial diseases when they reduce yields.

## ANTHRACNOSE

The fungus *(Colletotrichum graminicola)* damages grain sorghum foliage and stems. On susceptible hybrids, the stem holding the head (peduncle) becomes infected, and a brown sunken area with distinct margins develops. When affected stems are cut lengthwise with a knife, one can see the fungus has penetrated the soft pith tissues and caused a brick red discoloration. This type of infection stops the flow of water and nutrients and essentially stops grain development.

This fungus also invades individual grains and the small stems that support them on the seed head. The invading fungus rapidly utilizes the stored food material in the grain, and rapid yield loss occurs. Harvest the crop as soon as stalk or head infection is seen in the field.

Damage from anthracnose has been restricted mostly to coastal areas with the greatest damage being in the coastal bend area. This damage has been reduced in recent years, however, with the use of more resistant hybrids. Since the organism is carried over in crop residue and on johnsongrass, practice good residue management and weed control.

## RUST

The rust fungus *(Puccinia purpurea)* causes small, raised pustules or blisters on the upper

Anthracnose symptoms in cut stem tissue. (*Horne*)

Rust on leaves. (*Frederiksen*)

and lower leaf surfaces. These pustules rupture and release many reddish-brown spores. Affected leaves are destroyed, and yields are adversely affected if infection occurs before head formation and grain filling.

The fungus occurs on johnsongrass as well as on sorghum and overwinters on that host in the southern production areas. Spores are windborne, but infection usually occurs late in the season causing little or no loss. Hybrids vary in their susceptibility to rust. No chemicals are cleared for use.

## HEAD MOLDS INCLUDING GRAIN MOLDS AND WEATHERING

Head molds, grain molds and weathering indicate the visual presence of fungi associated with grain sorghum heads under field conditions. Fungi growing on glumes and grain surfaces cause discolored heads and dark colored thrashed grain. Head molds caused by fungi such as *Alternaria* sp., *Curvularia* sp. and *Cladosporium* sp. cause little yield loss under normal growing conditions, and feeding value is not usually impaired. Certain other fungi, however, such as *Colletotrichum graminicola* and *Fusarium moniliforme* cause substantial yield loss. A discussion of these conditions appears under the anthracnose and Fusarium head blight sections.

Head mold (right). (*Rosenow*)

Infection by head mold organisms occurs from grain formation to complete maturity depending on high moisture conditions. Yield loss potential is dependent on weather conditions that favor organism development. Prolonged wet conditions that prevent harvesting at the normal time may cause weathering and yield loss.

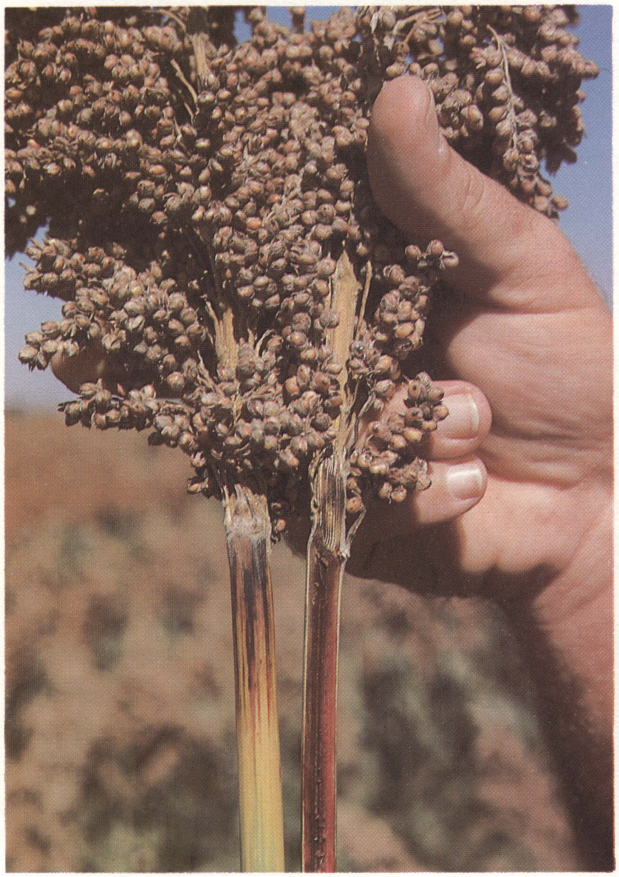
Some types of grain sorghum are more resistant to head molds than others. In the more humid production areas, it is advisable to select resistant types to avoid damage or off-color grain. While certain fungicides effectively control head molds, they do not have Environmental Protection Agency approval. Harvest mature grain as soon as the proper moisture level is reached to avoid weathering effects.

Closeup of head mold. (*Castor*)

## FUSARIUM HEAD BLIGHT

Fusarium head blight caused by the fungus *Fusarium moniliforme* occurs most commonly along the Gulf Coast production areas but has also occurred on the Texas High Plains during wet seasons. The fungus is widely distributed in nature and is capable of infecting sorghum heads at and soon after blooming. Structures supporting the grain in the head (panicles and rachis branches) become infected first followed by infection of stalk tissue at and immediately below the head. Weak neck and stalk lodging may follow.

Significant yield loss occurs even if harvest grain appears normal. When the organism attacks the rachis branches that hold the grain, the flow of nutrients and water is impaired if not terminated. This results in smaller and lighter grains.



Fusarium head blight. (*Frederiksen*)

The seed mold phase of the disease is less common. When it occurs, however, a pink mold covers the grain. This is more likely to occur along the Gulf Coast production areas when high moisture conditions prevent normal harvest.

The fungus causing Fusarium head blight is capable of causing seedling blight, stalk rot, head blight and grain mold of sorghum. These typically do not occur together and are considered separate diseases. Grain sorghum hybrids vary in their susceptibility to this organism. While none are immune, some sustain less damage and suffer less economic loss. Consult your seed company for information on individual hybrid resistance.

## SMALL SEED

In many instances, individual grains are abnormally small. The problem may appear on a few plants or generally across large areas. The reduction in seed size varies from slight to severe, and it may appear on any part of the head or the entire head. A reduction to about half of normal size is the most common observation.

The problem occurs throughout the sorghum belt, but it appears more commonly in heavily fertilized and irrigated fields. Crown and root rot organisms may contribute to the problem, but no evidence exists for this theory. Some observers report differences between hybrids, but no definitive listing has been prepared.

The most likely explanation is that unidentified adverse environmental conditions are terminat-

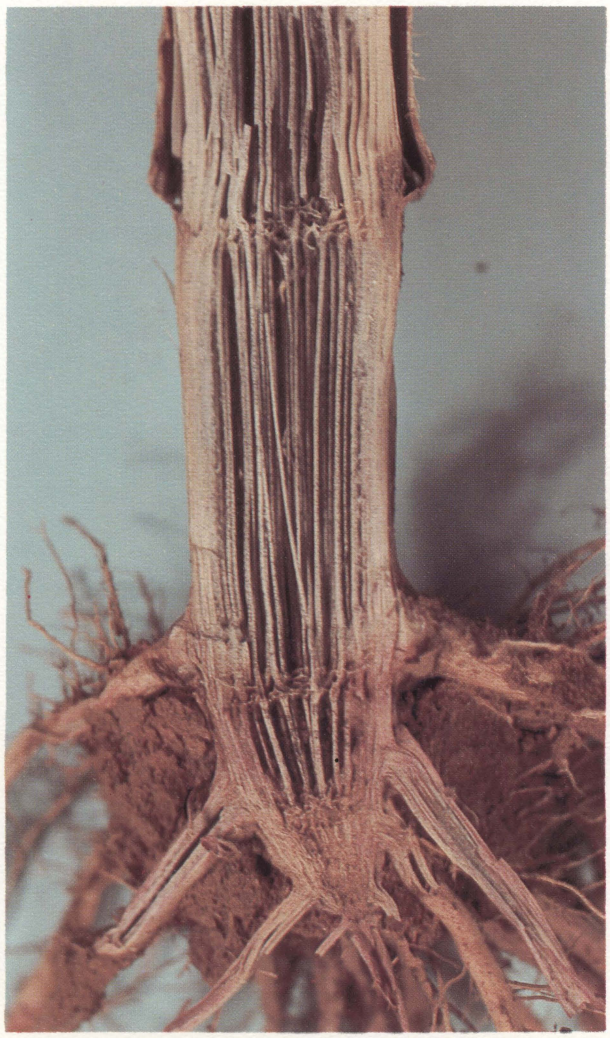
Small seed. (*Rosenow*)

ing grain development before all seed reach full size. The causal mechanism may operate early in the growing season or later during the grain-filling stage. However, the symptoms are not evident until the heads near maturity. The small seed condition has a questionable effect on yields since fields with moderately small seed often produce the top yields in the community.

## CHARCOAL ROT

Grain sorghum plants affected by the charcoal rot fungus *Macrophomina phaseolina)* fail to fill properly and may lodge in the latter part of the season. The disease is identified easily under field conditions by splitting the stalk lengthwise near the ground line and looking for shredded tissue. Activity of the fungus within the plant tissue causes the softer portions to be consumed and the tougher vessels to be left. Small, dark, fungal bodies cover the vessel bundles, and they give the tissue a charcoal color.

The charcoal rot fungus actively invades plant tissue when plants are under drought stress at grain formation. Drought does not cause the problem, but it permits the fungus to invade tissues. If drought stress can be avoided with lower planting rates or irrigation, the problem may not develop. Some hybrids have a stiffer stalk and do not lodge as badly as others following infection.



Charcoal rot. (*Frederiksen*)

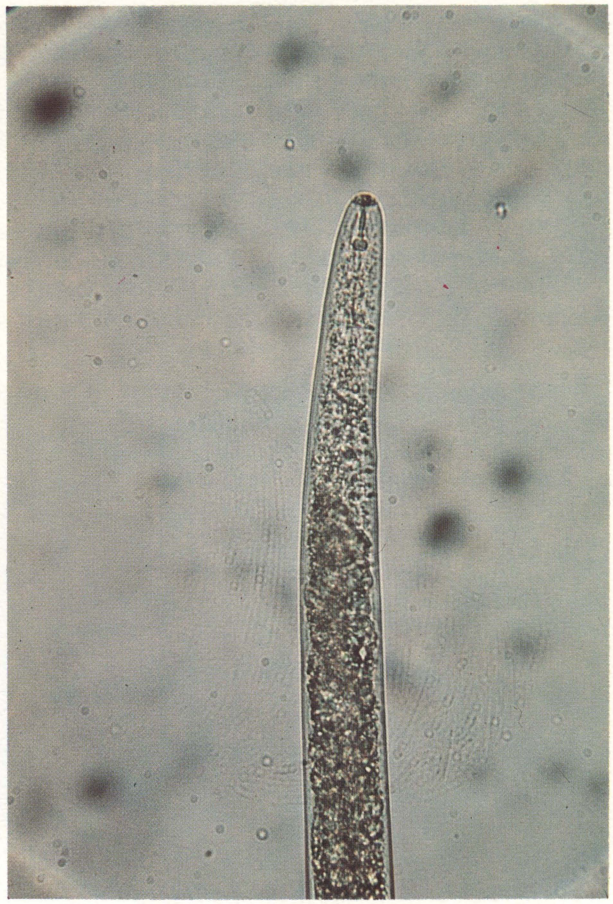
## OTHER STALK ROTS

Other fungal organisms *(Colletotrichum graminicola, Phythium* spp. and *Fusarium* spp.) also cause stalk rots. Stalk rot caused by these fungi is more difficult to specifically identify than charcoal rot. While charcoal rot is more likely to occur under hot, dry conditions, stalk rots are more likely to occur under cool, wet conditions.

Controlling stalk rots is often difficult. Growers experiencing this problem should rotate with unrelated crops and handle crop residue so that it breaks down quickly. Some hybrids are more tolerant.

Pythium root rot. (*Rosenow*)

Fusarium stalk rot. (*Frederiksen*)



Head region of root lesion nematode. (*Horne*)

## NEMATODE INJURY

Several different nematode species (*Meloidogyne* spp., *Pratylenchus* spp., *Trichodorus* sp. and *Belonolaimus* sp.) attack the roots of grain sorghum and cause reduced yields. Affected plants are stunted and show symptoms resembling inadequate fertility. This type of damage is usually noted only in sandy soils. If irregular growth patterns are indicated, nematode damage may be suspected. For diagnosis, send a soil sample to the Plant Nematode Detection Laboratory at College Station, Texas. Contact your county Extention agent for submission forms along with instructions for taking samples.

## CONCLUSIONS

Correct disease identification is the first step in preventing sorghum disease losses. This publication was prepared to help growers make specific identifications of major diseases. Some minor diseases are not included, and help may be needed in their diagnosis. Your county Extension agent can assist with diagnosis or can send samples to a Plant Disease Diagnostic Laboratory operated by the Texas Agricultural Extension Service. Your local seed company representative can assist also.



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